

# **CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS**

## **Chapter 12**

### **ASPHALTIC CONCRETE**

<b>ARTICLE</b>	<b>TITLE</b>
12.00	General
12.01	Related Items Specified Elsewhere
12.02	Materials
	A. Asphalt Binder
	B. Tack Coats
	C. Mineral Aggregates
	D. Non-woven Pavement Overlay Fabric
12.03	Asphaltic Concrete Mixtures
	A. General
	B. Volumetric Mix Design
	C. Materials Sampling and Testing
	D. Mix Design Criteria
	E. Aggregate Criteria
12.04	Equipment
	A. General
	B. Mixing Plant
	C. Truck Scales
<b>TABLES</b>	<b>TITLE</b>
12.00	Asphaltic Concrete Mix Requirements Summary
12.01	Gyratory Compaction Effort
12.02	Compaction Criteria
12.03	Voids in Mineral Aggregate
12.04	Voids Filled With Asphalt
12.05	Aggregate Adjustment Tolerance
12.06	Coarse Aggregate Angularity
12.07	Fine Aggregate Angularity
12.08	Flat and Elongated Particles
12.09	Clay Content
12.10	Gradation Control Points for 0.375 Nominal Size
12.11	Gradation Control Points for 0.500 Nominal Size
12.12	Gradation Control Points for 0.750 Nominal Size

## CHAPTER 12

### ASPHALTIC CONCRETE

#### 12.00 GENERAL

Asphaltic Concrete mixtures shall be classified as “Arterial Street”, “Non Arterial Street”, or “Parking Area” and shall consist of an intimate mixture of naturally occurring mineral aggregates of required gradations and asphalt binder content as hereinafter specified. Unless otherwise specified, no recycled or reclaimed pavement materials nor industrial or manufacturing byproducts will be allowed in the mixture. Asphaltic concrete shall be measured and paid for as provided in Chapter 5 of these Specifications.

#### 12.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 1	Pavement Construction & Reconstruction
Chapter 2	Earthwork
Chapter 4	Portland Cement Concrete Base
Chapter 5	Asphaltic Concrete Construction

#### 12.02 MATERIALS

##### A. ASPHALT BINDER

The suppliers for asphalt binder used in City of Lincoln projects shall be certified by the Nebraska Department of Roads to supply Performance Graded Binder in Nebraska.

The asphalt binder for all mixes shall conform to the requirements of AASHTO M 320 for Performance Graded Asphalt Binder. The PG Binder shall meet or exceed both the upper and lower temperature targets of PG 70-28 for Arterial Street and Non Arterial Street mixes and PG 64-22 for Parking Area mixes and mixes used in temporary pavement or pavement patching unless directed otherwise by the Engineer.

In addition, unless for use in temporary pavement or otherwise directed by the Engineer, the PG Binder for Arterial Street and Non Arterial Street mixes shall be Polymer Modified. Polymer Modified Asphalt Binder shall be polymerized with a minimum of 3%, by weight, of virgin SB/SBS (styrene-butadiene or styrene-butadiene-styrene block copolymers) or SBR (styrene-butadiene rubber latex or polychloroprene latex). The composite material shall be thoroughly blended at the asphalt refinery or terminal prior to being loaded into the transport vehicle. The polymer modified binder shall be heat and storage stable and shall not separate when handled and stored per the suppliers storage and handling recommendations.

A Material Certification from the PG Binder Supplier shall be submitted prior to construction, stating the type of polymer modifier being used and the recommended mixing and compaction temperatures for the Hot Mix Asphalt. The Material Certification must state that acid has not been used. The Material Certification must also state that the material has not been air blown or oxidized.

When moisture susceptibility testing indicates the need for an anti-stripping additive, it shall be added by the PG Binder Supplier. The Contractor shall be compensated for the cost of the anti-stripping additive at the invoice price of the additive. The bill of lading or delivery ticket shall state the binder grade, specific gravity, and the percentage of anti-strip additive.

## **12.02 MATERIALS (Continued)**

### **B. TACK COATS**

#### **1. Rapid-Curing Cut-Back Asphalts**

The rapid-curing cut-back asphalts to be used as tack coats shall conform to the requirements of AASHTO M 81, Cut-Back Asphalt (Rapid-Curing Type).

This Specification covers liquid petroleum products, produced by fluxing an asphaltic base with suitable petroleum distillates.

#### **2. Emulsified Asphalts**

Emulsified asphalts shall conform to the following Specifications:

ASTM Designation D 977	Standard Spec. for Emulsified Asphalts
ASTM Designation D 2397	Standard Spec. for Cationic Emulsified Asphalts
ASTM Designation D 140	Standard Practice for Sampling Bituminous Materials
ASTM Designation D 244	Standard Testing Emulsified Asphalts:

Emulsified asphalts covered by these Specifications shall be diluted in the distributor with sufficient potable water to reduce the asphalt residue in the mixture to approximately thirty percent (30%). Emulsified asphalt shall be homogeneous within the thirty (30) days after delivery. If separation of the emulsified asphalt has not been caused by freezing, thorough mixing shall be used to achieve a homogeneous mixture.

### **C. MINERAL AGGREGATES**

#### **1. General**

Mineral aggregates for asphaltic concrete shall conform to the following requirements except where modified herein:

ASTM Designation D 692	Standard Specification for Coarse Aggregate for Bituminous Paving Mixture
ASTM Designation D 1073	Standard Specification for Fine Aggregate for Bituminous Paving Mixture
ASTM Designation D 242	Standard Specification for Mineral Filler for Bituminous Paving Mixture

## 12.02 MATERIALS (Continued)

### C. MINERAL AGGREGATES (Continued)

#### 1. General (Continued)

Mineral aggregates shall be crushed rock, broken stone, gravel, sand-gravel, coarse sand, fine sand or a mixture of these materials composed of clean, hard, durable, and non-coated particles, free from injurious quantities of clay, dust, soft or flaky particles, loams, shale, alkali, organic matter, or other deleterious material. Crushed rock shall be crushed limestone, granite, quartzite, or other ledge rock approved for the intended purpose by the City and shall not contain deleterious substances in a quantity exceeding three and one-half percent (3.5%) of any combination of shale, clay lumps, coal, or soft particles with shale and clay lumps not to exceed one and one-half percent (1.5%).

The absorption of water by crushed rock for use in asphaltic concrete shall not exceed three and two-tenths percent (3.2%) by weight.

The gradations from any one source shall be reasonably uniform. The mineral aggregate from different sources of supply shall not be mixed or stored in the same pile, nor used alternately in the same class of construction or mixed without permission from the Engineer. All fractions of a crushed rock gradation shall be produced from the same type of material.

The chemical and physical characteristics of the fraction passing the # 4 sieve shall be substantially the same as those of the material which may be produced in the laboratory from the fraction which is retained on the # 4 sieve.

Mineral aggregates shall have a soundness loss of not more than 12 percent by weight at the end of 5 cycles using sodium sulfate solution.

The mineral aggregate may be tested prior to its use. Generally only mineral aggregates that have been used for similar work and have satisfactory service records will be approved. If, in the opinion of the Engineer, the mineral aggregate warrants further testing, the sampling and testing will conform to the following requirements:

ASTM C 127	Specific Gravity & Absorption of Coarse Aggregates.
ASTM D 75	Standard Practice for Sampling Aggregates.
ASTM C 136	Standard Test Method for Sieve Analysis of Fine & Coarse Aggregates.
ASTM D 546	Standard Test Method for Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures.
ASTM C 128	Specific Gravity & Absorption of Fine Aggregates.
ASTM C 131	Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion Impact in the Los Angeles Machine.
ASTM C 88	Standard Test Method for Soundness of Aggregate.
ASTM D 693	Standard Spec. for Crushed Aggregate for Macadam Pavements.

## 12.02 MATERIALS (Continued)

### C. MINERAL AGGREGATES (Continued)

#### 2. Mineral Fillers

Mineral filler shall consist of pulverized soil, pulverized crushed rock, broken stone, gravel, sand-gravel, sand, or a mixture of these materials that conforms to the following requirements:

Total Percent Passing:	Minimum	Maximum
# 50 (300 $\mu$ m) Sieve	95	100
# 200 (75 $\mu$ m) Sieve	80	100
Plasticity Index [material passing #200 (75 $\mu$ m)]	0	3
Plasticity Index for Soil	0	6

### D. NON-WOVEN PAVEMENT OVERLAY FABRIC

Non-woven overlay fabric shall be needle punched, polypropylene fabric conforming to the following requirements:

PROPERTY	TYPICAL	MINIMUM
Mass, g/m <sup>2</sup>	145	129
Tensile Strength, newton (N)	512	400
Elongation at Break, %	60	55
Mullen Burst Strength, kPa	1515	1375
Asphalt Retention, L/m <sup>2</sup>	----	0.90

Acceptance shall be based upon manufacturer's certification of conformity.

## 12.03 ASPHALTIC CONCRETE MIXTURES

### A. GENERAL

Asphaltic concrete mixtures shall be designed by the Contractor, according to the Asphalt Institute Superpave Mix Design Series No. 2 (SP-2), to meet the Mix Design Criteria for the appropriate mix class as shown in these specifications.

The Contractor will be required to define properties using a gyratory compactor, that has met the Superpave evaluation test procedures, according to the gyrations levels indicated in Table 12.01 for the mix type specified.

Unless otherwise specified or approved by the Engineer, Asphaltic Concrete for Arterial Street Mix shall meet or exceed all of the requirements for Asphaltic Concrete type "SP4" as described in these specifications.

## 12.03 ASPHALTIC CONCRETE MIXTURES (Continued)

### A. GENERAL (Continued)

Unless otherwise specified or approved by the Engineer, Asphaltic Concrete for Non Arterial Street Mix and Parking Area Mix shall meet or exceed all of the requirements for Asphaltic Concrete type "SP4 Special" as described in these specifications.

Unless otherwise specified or approved by the Engineer, the Blended Aggregate for Arterial Street Mix shall contain no more than 80 percent limestone and shall meet the requirements of Table 12.11, Gradation Control Points For 0.500 (1/2) Inch Nominal Size.

Unless otherwise specified or approved by the Engineer, the Blended Aggregate for Non Arterial Street Mix shall contain no more than 80 percent limestone and shall meet the requirements of Table 12.11, Gradation Control Points For 0.375 (3/8) Inch Nominal Size.

Unless otherwise specified or approved by the Engineer, the Blended Aggregate for Parking Area Mix and temporary pavement mixes shall contain no more than 80 percent limestone and shall meet the requirements of either Table 12.11, Gradation Control Points For 0.500 (1/2) Inch Nominal Size or Table 12.11, Gradation Control Points For 0.375 (3/8) Inch Nominal Size.

Table 12.00 is a summary of the general mix requirements for the standard City of Lincoln asphalt mixes. Actual design and material criteria are described in following sections of this specification. Deviation from these requirements must be approved by the Engineer.

Table 12.00  
ASPHALTIC CONCRETE MIX REQUIREMENTS SUMMARY

	Arterial Street	Non Arterial Street	Parking Area
Superpave Level	SP4	SP4 Special	SP4 Special
PG Binder Grade *	70-28 Polymer Mod.	70-28 Polymer Mod.	64-22
Gradation Band **	1/2"	3/8"	1/2" or 3/8"
Compaction Min. ***	92.5%	92.5%	92.5%

\* Binder grade for temporary asphalt pavement and patching areas shall be PG 64-22 or as approved by the Engineer.

\*\* Applies to surface lift, lower lifts in full depth asphalt pavement may use 3/4" band if approved by the Engineer.

\*\*\* Required for 100% pay.

## 12.03 ASPHALTIC CONCRETE MIXTURES (Continued)

### B. VOLUMETRIC MIX DESIGN

The mix formula shall be determined by the Contractor from a mix design for each mixture. A volumetric mixture design in accordance with the latest edition of the Asphalt Institute Publication, SP-2 will be required. However, the mixture for the Superpave specimens and maximum specific gravity mixture shall be short-term aged for two hours.

The following test procedures shall apply:

- AASHTO R 30 - Practice for Short and Long-Term aging of Hot Mix Asphalt
- AASHTO T 84 - Specific Gravity and Absorption of Fine Aggregate
- AASHTO T 85 - Specific Gravity and Absorption of Coarse Aggregate
- AASHTO PP 19 - Practice for Volumetric Analysis of Compacted Hot Mix Asphalt
- AASHTO T 312 - Method for Preparing and Determining the Density of Hot Mix Asphalt Specimens by Means of the Superpave Gyratory Compactor
- AASHTO T 209 - Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
- AASHTO T 283 - Resistance of Compacted Bituminous Mixture to Moisture induced Damage

The optimum binder content shall be the binder content that produces required air voids, at Ndes, in the plant produced mix. The design shall have at least four points, including a minimum of two points above and one point below the optimum. The amount of uncompacted mixture shall be determined in accordance with AASHTO T 209.

Each Superpave mixture shall be tested by the Contractor for moisture susceptibility in accordance with AASHTO T 283. The loose mixture shall be short-term aged for two hours in accordance with AASHTO R30. The 6-inch specimens shall be compacted in accordance with AASHTO T 312 to 7 percent air voids at 95-mm in height and evaluated to determine if the minimum Tensile Strength Ratio (TSR) of 80 percent has been met. If the mixture has not met the minimum TSR value, a liquid anti-stripping additive shall be added to the PG Binder, by the PG Binder Supplier, at a dosage rate, such that the mix will meet the minimum TSR of 80 percent. All data shall be submitted with the mix design for approval. During production, the Contractor may be required by the Engineer, to provide and test additional specimens of the plant produced asphaltic concrete for moisture susceptibility. A TSR test result of less than 80 percent will require mixture modification(s) and a sample from subsequent lots will be tested by the Contractor until a TSR value of at least 80 percent is achieved.

Changes in the types or sources of aggregates or binder shall require a new job mix formula, mix design, and moisture susceptibility test. The new proposed job mix formula shall be in accordance with the requirements as stated above and submitted 5 working days prior to use for approval.

## **12.03 ASPHALTIC CONCRETE MIXTURES (Continued)**

### **C. MATERIALS SAMPLING AND TESTING**

At the beginning of each year and at least 14 days before production of asphaltic concrete, the Contractor shall submit, in writing, a tentative job mix formula and material samples as described below, for approval, to the City of Lincoln Materials Testing Laboratory. The job mix formula shall identify the mineral aggregates and mineral filler, if needed, with the value of the percent passing each specified sieve for the individual and blended materials.

A 65 pound bag of each of the individual mineral aggregates shall also be submitted to the City at this time. Each sample shall be marked to clearly indicate the type of material, name of the producer, and the pit location.

The contractor shall submit, to the City Testing Lab, three proportioned 10,000-gram samples of the blended aggregates and a 1 gallon sample of the asphalt binder to be used in the mixture. Submitted with these samples shall be a copy of the mix design values obtained from tests performed by the Contractor. This mix design shall include at a minimum, the following information.

- The bulk specific gravity of each aggregate
- The bulk specific gravity of the blended aggregate (To be determined from the combined blend on the - #4 and the + #4 sieves in accordance with AASHTO T 84 & T 85 respectively)
- The target asphalt binder content by total mix
- The supplier, grade, and specific gravity of the PG Binder
- The maximum specific gravity of the combined mixture (Rice)
- The average bulk specific gravity and air voids at N initial (Nini), N design (Ndes), and N maximum (Nmax) of the compacted gyratory specimens
- Voids in the Mineral Aggregate (VMA) and Voids filled with Asphalt (VFA) at Ndes
- Fine Aggregate Angularity (FAA), Coarse Aggregate Angularity (CAA), Flat and Elongated Particles and Clay Content of the aggregate blend

When recycled mixes are specified, the Contractor shall submit a 65 pound sample of the reclaimed asphalt pavement (RAP) with the samples of virgin aggregates as described above, for determination of asphalt binder content, gradation and bulk specific gravity of RAP material. RAP material that is not reasonably uniform in asphalt binder content and gradation shall not be used in City of Lincoln projects. The Contractor shall include with the mix design of recycled mixes the percent of added asphalt binder and the total asphalt binder percent. Recycled mixes shall contain no more than 15% RAP by total weight of mix.

During production, asphaltic concrete shall be sampled and tested for quality by the City on a lot basis as defined in Chapter 5.06 paragraph C of these specifications. Tests shall include the following:



## 12.03 ASPHALTIC CONCRETE MIXTURES (Continued)

AASHTO T 209	Maximum specific gravity of the mix (Rice)
ASTM C 136	Standard Test Method for Sieve analysis of Fine and Coarse Aggregate
AASHTO T312	Method for Preparing and Determining the Density of Hot Mix (HMA) Asphalt Specimens by Means of the Superpave Gyratory Compactor
AASHTO T 166	Bulk Specific Gravity of compacted Bituminous Mixtures using saturated surface-dry specimens
National Center for Asphalt Technology	Asphalt binder content of total mix by ignition

### D. MIX DESIGN CRITERIA

The design criteria for each mixture shall be determined from Tables 12.01, 12.02, 12.03, and 12.04.

The optimum binder content shall be the binder content that produces 4.0% +/- 1% air voids at Ndes for all mix types except type SPS where the optimum binder content shall be that which produces air voids at Ndes of 1.5% to 5.0%.

Table 12.01  
GYRATORY COMPACTION EFFORT  
Average Design High Air Temperature = < 39 degrees C (102° F)

Asphaltic Concrete Type	Nini	Ndes	Nmax
SPS	6	40	62
SP1	7	68	104
SP2, SP4 SPECIAL	7	76	117
SP3	7	86	134
SP4	8	96	152
SP5	8	109	174

Table 12.02  
COMPACTION CRITERIA

Mix Criteria	SPS,SP1	SP2	SP3,SP4, SP4 SPECIAL,SP5
%Gmm at Nini (Max.)	91.5 *	90.5	89.0
%Gmm at Nmax (Max.)	98.0 *	98.0	98.0

\*No specification requirement for SPS, only %Gmm at Ndes = 95.0 to 98.5

## 12.03 ASPHALTIC CONCRETE MIXTURES (Continued)

### D. MIX DESIGN CRITERIA (Continued)

Table 12.03  
VOIDS IN MINERAL AGGREGATE  
Criteria at Ndes

Nominal Maximum Aggregate Size	Minimum VMA, Percent
3/8 (0.375) inch	15.0
1/2 (0.500) inch	14.0
3/4 (0.750) inch	13.0

Table 12.04  
VOIDS FILLED WITH ASPHALT  
Criteria at Ndes

Asphaltic Concrete Type	Design VFA, Percent
SPS	N/A
SP1	70 - 80
SP2,SP3	65 - 78
SP4,SP4 Special,SP5	65 - 75

If at the end of the day's production, either of the two following conditions occur, the Contractor will not be allowed to resume production until corrective adjustments are made to the mix design:

1. Air Voids, VMA, VFA, FAA, CAA or Binder content do not meet the currently approved criteria.
2. Rutting occurs.

Mix adjustments at the plant are authorized within the limits shown in Table 12.05 without redesigning the initially approved mix.

The adjustment must produce a mix with the percent air voids and all other properties as stated in these specifications.

All adjustments must be reported to the Engineer.

The adjustment values in Table 12.05 will be the tolerances allowed for changes indicated by production or mix design test results, but cannot deviate from Superpave gradation criteria.

## 12.03 ASPHALTIC CONCRETE MIXTURES (Continued)

### D. MIX DESIGN CRITERIA (Continued)

Table 12.05  
AGGREGATE ADJUSTMENT TOLERANCE

Aggregate Adjustments	
Sieve Size	Adjustment Range
1 inch, 3/4 inch, 1/2 inch, 3/8 inch	± 6%
No. 8, No. 16, No. 30, No. 50	± 4%
No. 200	± 2%

### E. AGGREGATE CRITERIA

#### 1 Coarse Aggregate Angularity (CAA)

The coarse aggregate angularity value of the blended aggregate material shall meet or exceed the minimum values for the appropriate asphaltic concrete type shown in Table 12.06.

Table 12.06  
COARSE AGGREGATE ANGULARITY  
(ASTM D 5821)

Asphaltic Concrete Type	CAA (minimum)
SPS	35
SP1	55
SP2	65
SP3	75
SP4,SP4 Special	85/80*
SP5	98/90*

\* Denotes two faced crushed requirements

Aggregate obtained from the residue of the ignition process shall not be used for the determination of CAA for mix design approval except when RAP material is specified and must be combined with the proportioned amount of virgin aggregate as defined by the mix design.

#### 2. Fine Aggregate Angularity (FAA)

The fine aggregate angularity value of the blended aggregate material shall meet or exceed the minimum values for the appropriate asphaltic concrete type shown in Table 12.07.

### 12.03 ASPHALTIC CONCRETE MIXTURES (Continued)

#### E. AGGREGATE CRITERIA (Continued)

##### 2. Fine Aggregate Angularity (FAA) (Continued)

The specific gravity for calculation of the FAA shall be based on a combined aggregate sample of material passing the No. 8 sieve and retained on the No. 100 sieve.

Table 12.07  
FINE AGGREGATE ANGULARITY  
(AASHTO T 304 Method A)

Asphaltic Concrete Type	FAA (minimum)
SPS	N/A
SP1	40.0
SP2,SP3	43.0
SP4,SP4 Special,SP5	45.0

Aggregate obtained from the residue of the ignition process shall not be used for the determination of FAA for mix design approval except when RAP material is specified and must be combined with the proportioned amount of virgin aggregate as defined by the mix design.

##### 3. Flat and elongated particles

The coarse aggregate shall not contain flat and elongated particles exceeding the maximum value for the appropriate asphaltic concrete type shown in Table 12.08.

Table 12.08  
FLAT AND ELONGATED PARTICLES\*  
(ASTM D 4791)

Asphaltic Concrete Type	Percent, Maximum
SPS	25
SP1,SP2,SP3,SP4,SP4 Special,SP5	10

\* Criterion based on a 5:1 maximum to minimum ratio

### 12.03 ASPHALTIC CONCRETE MIXTURES (Continued)

#### E. AGGREGATE CRITERIA (Continued)

##### 4. CLAY CONTENT

The Clay Content of the blended aggregate material shall be such that the Sand Equivalent Minimum value for the appropriate asphaltic concrete type as shown in Table 12.09, shall be met or exceeded.

Table 12.09  
CLAY CONTENT  
(AASHTO T 176)

Asphaltic Concrete Type	Sand Equivalent, Minimum
SPS	30
SP1,SP2	40
SP3,SP4,SP4 Special,SP5	45

##### 5. Gradation

The blended aggregate shall conform to the gradation requirements specified below for the appropriate nominal size.

For Superpave mixes where the FAA requirement is less than 45.0, the plot of the selected blended aggregate gradation shall not pass through the restricted zones as specified in the following control points for nominal size unless approved by the Engineer based on material characteristics.

The dust to binder ratio is the ratio of the percentage by weight of aggregate finer than the No. 200 sieve to the asphalt content expressed as a percent by weight of total mix. The dust to binder ratio shall be between 0.6 and 1.6. This shall be verified during mix design approval and production sample testing.

### 12.03 ASPHALTIC CONCRETE MIXTURES (Continued)

#### E AGGREGATE CRITERIA (Continued)

##### 6. Gradation (Continued)

Table 12.10  
GRADATION CONTROL POINTS FOR 0.375 (3/8) INCH NOMINAL SIZE

Sieve	Control Points (percent passing)		Restricted Zone Boundary (percent passing)	
	Minimum	Maximum	Minimum	Maximum
½ inch	100.0			
3/8 inch	90.0	100.0		
No. 4		90.0		
No. 8	32.0	67.0	47.2	47.2
No. 16			31.6	37.6
No. 30			23.5	27.5
No. 50			18.7	18.7
No. 200	2.0	10.0		

Table 12.11  
GRADATION CONTROL POINTS FOR 0.500 (½) INCH NOMINAL SIZE

Sieve	Control Points (percent passing)		Restricted Zone Boundary (percent passing)	
	Minimum	Maximum	Minimum	Maximum
¾ inch	100.0			
½ inch	90.0	100.0		
3/8 inch		90.0		
No. 8	28.0	58.0	39.1	39.1
No. 16			25.6	31.6
No. 30			19.1	23.1
No. 50			15.5	15.5
No. 200	2.0	10.0		

## 12.03 ASPHALTIC CONCRETE MIXTURES (Continued)

### E. AGGREGATE CRITERIA (Continued)

#### 6. Gradation (Continued)

Table 12.12  
GRADATION CONTROL POINTS FOR 0.750 (3/4) INCH NOMINAL SIZE

Sieve	Control Points (percent passing)		Restricted Zone Boundary (percent passing)	
	Minimum	Maximum	Minimum	Maximum
1 inch	100.0			
3/4 inch	90.0	100.0		
½ inch		90.0		
No. 8	23.0	49.0	34.6	34.6
No. 16			22.3	28.3
No. 30			16.7	20.7
No. 50			13.7	13.7
No. 200	2.0	8.0		

## **12.04 EQUIPMENT**

### **A. GENERAL**

All equipment, tools and machinery shall be adequate for the purpose for which it is to be used and shall be maintained in satisfactory working condition at all times. The following listed units of equipment shall conform to the requirements specified herein.

The Contractor shall furnish the necessary accessories and personnel and shall perform calibrations on the equipment. Copies of the calibration data shall be provided to the Engineer before production of Asphaltic Concrete. In the event problems are encountered during the calibrations, the Contractor shall arrange for a trained technician or company representative of the company from which the equipment was obtained to make the necessary repairs and/or adjustments to the equipment. Calibrations shall be made as often as is deemed necessary by the Engineer to ensure accuracy of the equipment.

In the event that a Contractor elects to obtain asphaltic concrete from a commercial plant not under his direct control, he shall reach agreement with the commercial producer to perform the above functions in the same manner as though the plant was under his direct control. The Contractor shall also reach agreement with the producer to furnish or shall arrange to have furnished an approved building for the use of an observer if deemed necessary by the Engineer.

### **B. MIXING PLANT**

#### **1. General**

The equipment that is used for heating, proportioning, and mixing the aggregates and asphalt cement shall be able to produce a uniform mixture.

The dryers shall be able to dry and heat all aggregates to the required temperatures with positive control. Aggregates shall be agitated continuously during the process of heating. Damage to the asphalt cement in dryer-drum type mixing plants shall be avoided.

Salvaged bituminous material shall not be exposed to open flame.

Continuous temperature and time readings of the asphaltic materials shall be electronically recorded whenever the plant is operated. A copy of the temperature reading shall be made available to the Engineer. Temperature and time displays shall be easily accessible. Temperature and time sensors will be provided at the following locations:

- a. Inside the asphaltic concrete mixture discharge chute.
- b. Inside the surge bin.
- c. Inside the asphalt cement storage tank.

During storage, the asphalt cement temperature shall be maintained between 250F and 350F or at the storage temperature range recommended by the binder supplier. All plants shall be equipped with a circulating system for asphalt cement which is



## 12.04 EQUIPMENT (Continued)

### B. MIXING PLANT (Continued)

#### 1. General (Continued)

designed to assure proper and continuous circulation during the operating period. Storage tanks shall have sufficient capacity to provide for continuous operation. The tanks shall be situated and constructed to allow the volume of the asphalt cement to be safely and accurately determined at any time.

If the plant is equipped with a surge bin for the temporary storage of asphaltic concrete, the asphaltic concrete taken from the surge bin will not differ significantly from the material taken directly from the plant. The first material entering the bin will be the first material removed. The surge bin shall be completely emptied at the end of each operating day unless insulated or heated.

All plants shall be equipped with a continuously operated dust collector. The collected material may be wasted or returned to the mix.

Mineral filler bins shall be protected from moisture.

#### 2. Pugmill Plants

##### a. General

Pugmill plants shall include cold aggregate feeders, oversize screens, storage bins for dried aggregate, ingredient proportioning devices, and all other equipment necessary to produce the specified mixture. The pugmill blades shall have a minimum clearance of 3/4 inch from all fixed and moving parts. The mixer shall be equipped with a discharge hopper holding approximately 1 ton of hot mixture and capable of intermittent discharge.

##### b. Batch Plants

Batch plants shall have an accurate time lock to control the operations during a complete mixing cycle. They shall lock the scale box gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle. They shall lock the bituminous material bucket throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods.

The dry mixing period is defined as the time between the opening of the scale box gate and the addition of bituminous material. The wet mixing period is the interval of time between the addition of bituminous material and the opening of the mixer gate.

The control of the timing shall be flexible and capable of being set at 5-second intervals or less throughout a total cycle of not less than 3 minutes. A

## **12.04 EQUIPMENT (Continued)**

### **B. MIXING PLANT (Continued)**

#### **2. Pugmill Plants (Continued)**

##### **b. Batch Plants (Continued)**

mechanical batch counter shall be installed as a part of the timing device and shall be designed and constructed to register only upon the release of the bituminous material. It shall not register any dry batches or any material wasted through the bins. The timing device shall have a suitable case with a locking door that shall always be kept closed and locked except when adjustments or repairs are required.

All batch plants shall be equipped with an asphalt cement volume meter or a heated or insulated asphalt bucket with scales.

Scale hoppers and scales for proportioning aggregates and asphalt to the batch plant's mixer shall be accurate within 0.5 percent; and they shall be sensitive within 0.2 percent or 2 pounds, whichever is greater, throughout the range of use.

##### **c. Continuous Type**

Plants shall be equipped with a pump synchronized to the feeding mechanism so that the required percentage of asphalt cement is applied continuously and uniformly. The feeding system shall be synchronized to the rest of the plant.

#### **3. Dryer-Drum Plants**

These plants shall include cold aggregate feeders, vibratory screening units for removing oversize material from both virgin and reclaimed material, proportioning devices for controlling the quantity of each ingredient in the mixture, and any other equipment necessary to produce the mixture as specified.

Plants shall be equipped with a pump synchronized to the feeding mechanism so that the required percentage of asphalt cement is applied continuously and uniformly. The feeding system shall be synchronized to the rest of the plant.

### **C. Truck Scales**

Truck scales shall be furnished by the Contractor for weighing loaded trucks at the plant site, and shall be installed on adequate foundations and in accordance with the manufacturer's recommendations. The scales shall have sufficient capacity to weigh the maximum axle, combination of axles or gross load used and shall be accurate to one-half percent (0.5%) of the total axle load or total load.

## **12.04 EQUIPMENT (Continued)**

### **C. Truck Scales (Continued)**

Scales shall be properly calibrated by the Contractor in the presence of the Engineer unless the scales have current Nebraska Department of Agriculture inspection approval or unless calibration and adjustment by a recognized scale company service crew has been performed during the current season, and attested to by a City of Lincoln representative. The scales shall be periodically cross-checked for accuracy during the course of the work by checking the net weight of loads of the material being produced on commercial scales in the vicinity of the project which have current agriculture inspection approval. The Contractor shall furnish at least ten (10) 50 pound weights for checking the accuracy of the scales. If the scale is not capable of weighing all axles at one time, the approaches shall be extended so the entire hauling unit will be level during weighing. Chuck holes, ruts or high spots in the approaches which develop during hauling operations shall be immediately repaired as directed by the Engineer.

All weighing shall be done with the hauling unit stationary, level, and out of gear. Suitable protection shall be provided against wind currents that may affect the accuracy of the scales. The platform of the scale shall be kept clean and free from accumulations of materials, as directed by the Engineer.

Serially numbered duplicated scale tickets shall be furnished to accompany each truck load of material to the unloading point. Scale tickets shall reflect the date, time, load number, total weight, tare weight, project number, mix type, destination, and net weight.